

manifestation of cortical necrosis, were seen in one patient.

The largest single group of patients, nine of a total of 38, had clinical features of shock during, or shortly after, abdominal surgical operation, and these had the highest incidence of acute tubular necrosis (four of the nine patients). No case of clinical shock of less than 12 hours' duration had tubular necrosis. Conversely, tubular necrosis was absent in three patients who were clinically in shock for 48 hours or more. There was no correlation between histological necrosis of tubules and the blood urea nitrogen concentration. Some patients with near normal blood urea nitrogen (BUN) had tubular necrosis, while other patients with BUN over 100 mg per 100 ml had normal kidneys. There was also no obvious relationship between urine flow and acute tubular necrosis.

These observations indicate that the incidence of acute tubular necrosis as a complication of shock is considerably less common than we anticipated and that it is remarkably unrelated to urine flow or blood urea concentration. The data would support the concept that renal failure and oliguria are related to decreased renal perfusion, in part attributable to intrarenal (Trueta) shunts.

## **The Peripheral Circulation During Shock**

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Studies were carried out on the comparative behavior of the resistance vessels in skin, kidney, cerebrum and skeletal muscle in dogs during hypotension and shock. Blood flow (electromagnetic) and effective perfusion pressure were measured: (1) during local hypotension produced by graded compressions of the arterial supply to the organ; (2) during systemic hypotension produced by graded withdrawal of blood in steps of 5 ml per kg of body weight until mean arterial pressure was reduced to 35 to 40 mm of mercury; (3) during hypotension maintained at  $35 \pm 5$  mm of mercury for 1.0 to 2.5 hours by additional withdrawals of blood as required; and (4) during the "irreversible" phase of shock (Chart 7). "Irreversible" shock occurred when the blood pressure fell further unless blood was reinfused. When the "up-

take" of blood reached 5 ml per kg, all remaining blood was returned to the animal. Arterial pressure rose and usually approached the control level, but then declined progressively until the animal died.

In the cerebrum, kidney and skeletal muscle, blood flow was usually maintained at near normal levels by local autoregulation in the face of declining perfusion pressure. However, vasoconstriction occurred in kidney and skeletal muscle, overpowered the autoregulation, and severely reduced flow in these organs as well as in the skin. In skeletal muscle, vasoconstriction was mediated by neural pathways, whereas both humoral and neurogenic mechanisms operated in the skin. Cerebral blood flow was maintained even though systemic arterial pressure decreased.

Vasodilation occurred in skeletal muscle and the cerebral bed during development of "irreversibility." This vasodilation in skeletal muscle may be an unfortunate decompensatory change accounting for the final progression of shock.

## **Reports from the USC Shock Research Unit on Practical Aspects of Management of the Critically Ill**

Miss Martha Kawabe, R.N., Head Nurse in the Shock Research Unit, discussed clinical management and research on the critically ill. She described the emergence of nursing in the computer age and indicated the remarkable efficiency and accuracy obtained with the aid of the computer in measuring arterial pressure, venous pressure, pulse rate, heart rate, urine output and other vital functions. The possibility of using the computer to regulate the rate of infusions and to initiate automatic heart pacing was reviewed. The implications of such medical technologic changes as they affect the training of nursing personnel were apparent.

David G. Stadelman, a mathematician who formerly served as principal programmer of the Shock Research Unit, discussed the interphase of computer technology and medicine and the feasibility of installing a computer in a hospital environment to assist in the management of patients. He demonstrated the potential value of automatic plotting and logging to relieve nursing and medical staffs of the time-consuming tasks that interrupt more direct care of the patient. The tremendous potential of improving understanding of the patient's condition by automatic presentation of information

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